



*U. S. Forest Service*

## RESEARCH NOTE NO. ITF 6

INSTITUTE OF TROPICAL FORESTRY\*  
RIO PIEDRAS, PUERTO RICO

FOREST SERVICE — U.S. DEPARTMENT OF AGRICULTURE

December 1966

### HERBICIDES FOR FOREST PLANTATIONS --1966

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#### Summary

MSMA, sodium cacodylate, diquat, aminotriazole, paraquat + surfactant, 2,4-D amine, ametryne, and picram were tested for use as herbicides in forest plantations.

MSMA gave best weed control per dollar of herbicide.

Picram also gave good control on dry sites, although more expensive than MSMA, but damaged planted trees.

When herbicides were applied during or just before a hard rain, none was satisfactory but paraquat was best.

Complete control of weeds by contact herbicides cannot exceed about two months, because within that time new plants replace those killed.

#### Resumen

Se hicieron experimentos con los herbicidas MSMA, sodium cacodylate, diquat, aminotriazole, paraquat + surfactant, 2,4-D amine, ametryne y picram para aplicarlos a plantaciones forestales.

Para controlar el crecimiento de malas hierbas, el MSMA dió los mejores resultados por dólar de herbicida.

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\* In cooperation with the University of Puerto Rico.

El picram tambien controló bien en sitios secos, pero es más costoso que el MSMA e hizo daño a los árboles plantados.

Cuando se aplicaron los herbicidas antes o durante lluvias fuertes, ninguno resultó satisfactorio pero el paraquat fué el mejor.

El control completo de hierbas malas por medio de herbicidas de contacto no debe exceder de alrededor de dos meses porque durante ese tiempo es que plantitas nuevas reemplazan las que se destruyen.

### Introduction

The most important factor restricting establishment of forest plantations in Puerto Rico, and in much of the tropics, is the competition from weeds. Tree seedlings grow rapidly, but not rapidly enough to escape smothering or distortion by the vines, grass, and herbs.

Cutting, intercropping, and mulching have been tried, among other control techniques, but herbicides seem to offer the most promise at present in Puerto Rico.

### Procedure

A preliminary screening test was applied to replicated 100m<sup>2</sup> plots at Sabana Seca in February 1966, at the beginning of the dry season. The site is at an elevation of 6 meters and receives an average of 1980 mm of rain per year. Soil was moist, but the weather was clear and hot at application. Herbicides were applied at the dosages recommended by the manufacturer<sup>1/</sup>.

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1/ Aminotriazole: 3-amino-1,2,4,-triazol (Weedazol); Amchem Products Inc., Niles, Calif. MSMA: Monosodium acid methanearsonate (Ansar 529); The Ansul Co., Marinette, Wis. Sodium cacodylate: Sodium cacodylate dimethylarsinic acid (Ansar 560); The Ansul Co., Marinette, Wis. Ametryne: 2-ethylamino-4-isopropylamino-6-methylthio-5-triazine (Ametryne 80-W); Maldonado Gómez Inc., Santurce, P.R. Paraquat: 1:1-dimethyl-4:4 bipyridinium cation (Gramoxone); Manuel del Valle Inc., PO Box RR, Hato Rey, P.R. 2,4-D: 2-4-dichlorophenoxy acetic acid; Chempar Chemical Co. Inc., 260 Madison Ave., New York, N.Y. Diquat: 1:1-ethylene-2:2-dipyridylum dibromide (Orthodiquat); California Chem. Co., Ortho Division, San Francisco, Calif.

Mention of commercial products does not imply endorsement by the Forest Service, U.S. Department of Agriculture.

After comparing the application costs and results at each site, MSMA and aminotriazole were selected for further testing at one-half, one, and twice their recommended levels, Table 3. Each level of one herbicide was applied to a 60m<sup>2</sup> block directly adjacent to the other chemical for obtaining best comparative results. The comparative results are given in Table 3, but control was not satisfactory on any of the plots, possibly because rain fell almost immediately after herbicide application.

Table 3.--Treatments and results in Test III

Herbicide	Dosage per acre	Comparative effect		Cost per acre
		<u>Dry site</u>	<u>Wet site</u>	
	<u>oz.</u>			
MSMA	145.2	B	A	\$4.40
MSMA	72.5	C	C	2.20
MSMA	36.3	C	none	1.10
Aminotriazole	726.0	A	C	44.00
Aminotriazole	363.0	C	C	22.00
Aminotriazole	183.0	C	none	11.00

Tests were continued with MSMA (cheapest chemical) and picram (highest priced, but most effective on the dry site) to seek the point of maximum effect per dollar's worth of chemical, Table 4. Two tests were laid out as in test III, except that two replications were used.

Table 4.--Treatments and results in Test IV

Herbicide	Dosage per acre	Comparative effect		Cost per acre
		<u>Dry site</u>	<u>Wet site</u>	
	<u>oz.</u>			
MSMA	580.8	A	A	\$17.60
MSMA	145.2	A	B	4.40
MSMA	72.5	B	none	2.20
Picram	58.1	B	↑ Vines only ↑	17.30
Picram	29.0	C		8.62
Picram	14.5	none		4.30

Table 1.--Herbicides and results of Test I

Herbicide	Period after application		
	1-month	2-month	3-month
	<u>Degree of control</u>		
Aminotriazole	Excellent	Very good	Fair
MSMA	Excellent	Good	Fair-poor
Sodium cacodylate	Very good	Fair	Poor
Ametryne	Very good	Fair-poor	Poor
Paraquat	Good	Poor*	Poor
2,4-D	Good	Poor	Poor
Diquat	Poor	Poor	Poor

\* For grasses only, Good.

The next tests were begun during the rainy season, November 1966. One pair of replications was at the same Sabana Seca location; an additional pair of replications was at Sabana de Luquillo, at about 150 meters elevation and with an annual rainfall of 3556 mm.

Tests at each location were identical in layout and dosage, except as specified. The four chemicals for Test II were applied at their recommended dosages in strips 10m by 30m. All of the chemicals at the dry site were considered effective, differences noted were only as to degree of control with "A" representing maximum control and "D" least control of weeds.

Table 2.--Treatments and results in Test II

Herbicide	Dosage per acre	Comparative effect		Cost per acre
	<u>oz.</u>	<u>Dry site</u>	<u>Wet site</u>	
Picram	116.0	A	D	\$34.50
Aminotriazole	363.0	B	B	22.00
Paraquat	58.0	D	A	12.50
MSMA	72.5	C	C	2.20

At the wet site, however, only paraquat could be classified as being effective at the applied dosage. In fact the comparative rankings of picram and paraquat were reversed at the wet and dry sites.

Table 5.--Treatments and results in Test V

Herbicide	Dosage per acre	Comparative effect	Cost per acre
	<u>oz.</u>	<u>Dry site</u>	
MSMA	580.8	A	\$17.60
MSMA	290.0	B	8.80
MSMA	145.2	C	4.40
Picram	116.2	A	34.50
Picram	58.1	B	17.30
Picram	29.0	B	8.62

After one month, test IV showed excellent results from MSMA on the dry site at all three levels, with a minimum effective dosage of 145.2 oz. per acre on the wet site. Test V was installed only at the dry site, during a light rain. This apparently decreased the effectiveness of MSMA.

As Test IV shows, rain also reduced the effects of picram, so only vines were affected at the wet site. Due to this characteristic, this chemical can be considered only for drier locations.

Although paraquat gave very good results at the recommended level on the wet site, Table 2, this same degree of effectiveness was achieved at lower cost with MSMA, Table 3.

Herbicide selectivity was recorded at both locations for MSMA and picram.

Table 6.--Effect of MSMA and picram on individual plant species

Species	Type of Vegetation <sup>1/</sup>	Herbicide Effect <sup>2/</sup>			
		Dry site		Wet site	
		Picram	MSMA	Picram	MSMA
Albizia lebbeck	W		TK		
Andira inermis	W				NE
Anthocephalus cadamba	W		<u>3/</u>		
Banisteria laurifolia	W				NE
Blechnum occidentale	H				TK
Borreria verticillata	H	NE	NE		
Bradburya virginiana	H	NE	NE		
Casearia arborea	W				NE
Casearia sylvestris	W				NE
Cenchrus pauciflorus	H	TK	TK		
Clitoria rubiginosa	H				NE
Commelina diffusa	H	NE	TK		
Cordia corymbosa	W				NE

Species	Type of Vegetation <sup>1/</sup>	Herbicide Effect <sup>2/</sup>			
		Dry site		Wet site	
		Picram	MSMA	Picram	MSMA
<i>Crotalaria striata</i>	H		NE		
<i>Cyperus rotundus</i>	H		TK		
<i>Dalbergia monetaria</i>	W				NE
<i>Desmodium supinum</i>	H		NE		
<i>Didymopanax morototoni</i>	W			NE	TK
<i>Dieffenbachia seguine</i>	W				NE
<i>Digitaria sanguinalis</i>	H	NE			
<i>Diodia sarmentosa</i>	H				NE
<i>Echites agglutinata</i>	H	NE			
<i>Galactia striata</i>	H	NE			
<i>Guettarda scabra</i>	W				NE
<i>Homalium racemosum</i>	W			NE	TK
<i>Hymenocallis declinata</i>	H		NE		
<i>Hyptis atrorubens</i>	H			NE	NE
<i>Icaina cordifolia</i>	H			NE	TK
<i>Indigofera suffruticosa</i>	W		NE		
<i>Jatropha gossypifolia</i>	H	NE			
<i>Malvastrum coromandelianum</i>	H		NE		
<i>Mimosa pudica</i>	H		NE		
<i>Paspalum glabrum</i>	H	NE			
<i>Passiflora foetida</i>	H	NE	NE		
<i>Setaria geniculata</i>	H	TK			
<i>Sida carpinifolia</i>	H	NE	NE		
<i>Sporobolus indicus</i>	H	NE	NE		
<i>Stachytarpheta jamaicensis</i>	H	NE			
<i>Stenotaphrum secundatum</i>	H	NE			
<i>Urena trilobata</i>	W		NE		

<sup>1/</sup> W - Woody                      H - Herbaceous

<sup>2/</sup> NE - No effect              TK - Top kill

<sup>3/</sup> Spraying to runoff killed some leaves, but no seedlings.  
 Unsprayed seedlings on sprayed plots showed no damage.